BIOECOLOGICAL STUDIES ON THREE FIG-LITTER DWELLING SPECIES OF RHYPAROCHROMINAE (INSECTA: HEMIPTERA: LYGAEIDAE)[1]

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(With six text-figures)

Some biological and ecological aspects like occurrence, feeding and reproductive behaviour, post-embryonic development with nymphal descriptions of three fig-litter dwelling rhyparochromine bugs, *Rhyparothesus bengalensis* (Distant), *Rhyparothesus sparsus* (Distant), and *Metochus uniguttatus* (Thunberg) are presented in this paper.

INTRODUCTION

Members of rhyparochrominae, the largest lygaeid subfamily, are in majority cryptic litter-dwellers and have therefore, attracted little attention of the naturalists. However, some recent contributions on the ecology and biology of these bugs from different parts of the globe are that of, Sweet (1964), Slater (1972 & 1975), Eyles (1963, 1964 & 1973), Malipatil (1975 & 1979), May (1965), Thomas (1955), Thompson and Simond (1964) and Putshkova (1956).

Bioecological information on Oriental rhyparochromines are scanty and fragmentary excepting some reports by Thangavelu (1978a) from southern India. Amongst the three fig-litter dwelling species studied here, *Rhyparothesus bengalensis* (Distant) and *Rhyparothesus sparsus* (Distant) are known only from Indian subregion, as compared to a wider distribution of *Metochus uniguttatus* (Thunberg) throughout the Orient. Maxwell-Lefroy (1909) reported *Rh. bengalensis* to abound in fallen leaves and debris at the base of the trunks of big trees like *Pipal* (Hindi) (Peepul, *Ficus religiosa*) associated with other rhyparochromines like *Elasmolomus sordidus* (Fabr.) and *Rh. orientalis* (Dist). Further he reported *M. uniguttatus* to frequent in fallen leaves and grass in India. However, Chatterjee (1937) reported the species from healthy sandal (*Santalum alba*). Except for the original description of *Rh. sparsus* and its report from India by Distant (1904) nothing is known about the binomics of the bug. So an attempt is made here to present some ecological and biological information of three of these commonly occurring rhyparochromine species of fig-litters in eastern India. The study is meant for better understanding of the life-style of these little known cryptic bugs and their beneficial role in nature.

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MATERIAL AND METHODS

(i) **Field collection:** All the three species of rhyparochromines were collected by using aspirator with interchangable vials and some times using the inlet tubes of different diameters depending on the size of the bug. Slight disturbance created in the litter- habitat triggered escaping movement of the cryptically coloured bugs and thereby helping in their location. For fast running large species, like *M. uniguttatus*, hand picking gave better result.

(ii) **Laboratory rearing:** Of the two culture methods, 'dirty' and 'clean' often recommended for lygaeids, the latter was preferable for studying the biology of the three rhyparochromine species in question. Small jars (10.5 cm x 9 cm) were chosen for studying the oviposition and fecundity of separate pairs of bugs while for mass rearing and studying some behavioural aspects larger jars (22 cm x 13 cm) were used. The mouths of the jars were covered with cloth. Nymphs were reared in separate vials (10 cm x 3 cm) for recording the nymphal stadia (by detecting exuvae). All the jars and vials were supplied inside with water siphons. The eggs studied for incubation period and hatching success were kept in separate small vials plugged with moistened cotton to provide adequate humidity.

OBSERVATIONS AND RESULTS

Habitats and food habits: The three species

of rhyparochromines were often found to share the same litter habitat of huge peepul trees (*Ficus religiosa* L.), but in different proportions. *Rh. sparsus* also occurred in litters of other figs, like *F. benghalensis* L. (Banyan) and *F. infectoria* Roxb. (*pakur*). Although adult and nymphs of *M. uniguttatus* were observed in litters of *F. religiosa* and *F. benghalensis*, their nymphs were also found associated with litter of *F. hispida* Linn. f. The long-legged adults and 5th instar nymphs of this bug were good runners, and therefore, often escaped from litter-habitat to surrounding meadows and vegetations and could be collected under grass or small weeds. In some places of southern West Bengal and in particular Sagar Island this bug was found to infest unripe pods of gingelly (*Sesamum indicum* DC.). *M. uniguttatus* was also recorded from the litter of *Artocarpus chapalasha* Roxb. (Moraceae) and *Lagerstroemia speciosa* Pers (Lythraceae) from northeastern states of India. From the same region *Rh. sparsus* is recorded from litter of *Duabanga sonneratioides* Ham. (Lythraceae).

From spring to autumn the peepul and banyan trees kept irregularly fruiting, thereby, keeping the bug-population flourishing in the litter of different fig trees. Nevertheless in the litter of non-fruiting trees at times some adults and late instar nymphs occurred. On rare occasions even in winter, if a peepul or banyan tree bore fruits or had enough dry seeds in the litter, adults and nymphs of all the three species with a number of other lygaeid bugs appeared. In general the colder part of winter (10° - 12°C) was tied over by all the three species in adult form.

The fig fruits and seeds present in the litter were the main source of food. The fruits dropped with ripening but their shedding was much enhanced by the feeding activity of a number of vertebrate commensals, such as bats, birds, and squirrels (Appendix 1). Seed remnants present in the droppings (faeces) of these agents were also appropriated by the bugs.

Seed defence habit was common to all the three species. Seeds were normally carried at the tip of rostrum to safe and secured places for feeding. Cannibalism was observed in adults and in late instars of *Rh. sparsus* but such a behaviour was uncommon for *Rh. bengalensis* and *M. uniguttatus*. *Rhyparothesus sparsus* adults were found feeding on 5th instar, and the latter again on the 4th instar of its own. Cannibalism took place even in presence of good supply of food and water but the propensity increased with the dearth of food and water. Advance nymphs of *M. uniguttatus* when handled without care occasionally inflicted mild bites.

Courtship and mating behaviour: The sexual behaviour was found almost similar for all the three species of rhyparochromine. The males of *Rh. sparsus* and *Rh. bengalensis* approached a receptive female with up and down movement of the antennae, whereas, the males of *M. uniguttatus* generally approached with their antennae straight and horizontal. When close to a receptive female, which kept steady, the male patted the female by stroking the antennae on its back. On final agreement the male mounted the motionless female often holding her by last two pairs of legs. The courting pair was found at times to be in a still state with the male partially mounted on the female for long periods. To a receptive female the male repeatedly leaned to one side to secure the attachment. After attachment, the male descended and turned in the opposite direction, so that the individuals of a copula faced away from one another. If a female refused to copulate, the male tickled the female first by two legs and antennal ends and then turned over her back for investigation.

All the three species repeatedly mated in the same season. In *Rhyparothesus* spp. a single mating lasted normally from half to one hour, whereas for *M. uniguttatus* it continued for about a couple of hours in undisturbed condition. The individuals of a copula of *Rh. sparsus* were often found to move their antennae and to continue feeding during the act. Gravid females of all the three species normally avoided male company and rejected any attempt of further mating. When kept in constant company of male, the freshly emerged virgins of *Rh. sparsus* started mating within a period of about six days and *Rh. bengalensis* within three days. Virgin *M. uniguttatus* laid a few unfertile

eggs without any male company.

Oviposition and fecundity: *Rhyparothesus sparsus* laid eggs scattered, feebly attached to litter substrate and in small furrows made in loose soil. In nature, *Rh. bengalensis* could not be observed laying but their laying habits in laboratory indicated their similarities with those of *Rh. sparsus*. In laboratory both the species preferred to attach their eggs to rough, pilose surfaces of cotton cloth, cotton wool and rough surfaces of fig fruits. Peculiar repetitive up and down movements of ovipositor (valves) and its scooping of loose soil particles were observed in the bugs. Eggs were normally laid scattered singly or in small groups of two or three. The apparent sticky nature of the eggs was due to minute warts on the chorion and a fluid on the egg surface. Eggs of *M. uniguttatus* were also difficult to locate in natural habitat. In laboratory eggs were singly attached to the covering cloth of the rearing jar, on rough surface of the fig fruits and at times on smooth glass surface, feebly glued, despite the presence of rough surfaces.

Both the species of *Rhyparothesus* laid on an average larger number of eggs than *M. uniguttatus*. However, for *Rh. sparsus* mean eggs laid per female and the average eggs laid per day per female was about double those of *Rh. bengalensis* (Table 1), nonetheless on considering daily laying rhythms the latter at times exceeded the former (Fig. 1).

Incubation: Although incubation periods were overlapping for all the three rhyparochromine species, yet eggs of *M. uniguttatus* hatched more successfully than those of other two *Rhyparothesus* species (Fig. 2). Successful hatching was estimated based on the total eggs collected for 12 consecutive days in early parts of laying periods (Table 2).

The eclosion phenomenon was essentially alike in all the three rhyparochromines. The pulsation caused by the embryo from within the egg resulted in a number of irregular cracks within the circlet of the micropylar processes. The cracks extended, making an opening for a wriggling nymph that emerged normally enveloped in an amniotic membrane. For a successful hatching the membrane either split-up while the nymph was half inside the chorion or when completely outside it, thereby freeing an active nymph. At times nymphs could not free themselves from the enveloping membrane and as a result perished . Hatching from a batch of egg was usually complete within three days but some eggs did not hatch at all. By the end of laying period a female often started laying fair number of empty, sunken and unfertilized eggs, this was more common for *Rh. sparsus* than the other two species.

TABLE 1

COMPARISON OF PREOVIPOSITION PERIOD, LONGEVITY AND FECUNDITY OF *Rh. sparsus*, *Rh. bengalensis* AND *M. Uniguttatus*

(BASED ON FIVE OBSERVATIONS)

Preoviposition period (Days)	Longevity Female (Days)	Total eggs laid / Female	Average eggs/ Female /diem
		Rh. sparsus	
Mean 9.8	27.0	23.0	11.31
Range (9-11)	(21-33)	(105-547)	(5-16.58)
S.D. 0.83	5.09	174.19	4.45
		Rh. bengalensis	
Mean 4.6	38.8	221.8	5.91
Range (4-5)	(26-52)	(177-262)	(4.15-7.42)
S.D. 0.54	9.33	38.8	1.33
		M. uniguttatus	
Mean 10.6	22.8	89.0	3.68
Range (9-12)	(17-29)	(19-171)	(1.1-5.9)
S.D. 1.14	4.76	55.23	1.8

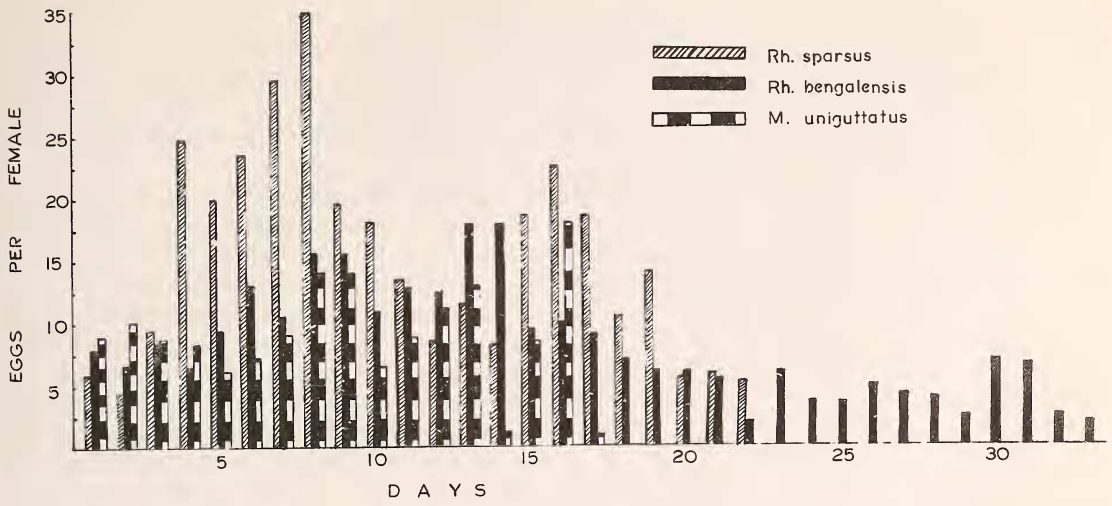


Fig. 1. Oviposition trends of three species of Rhyparochrominae.

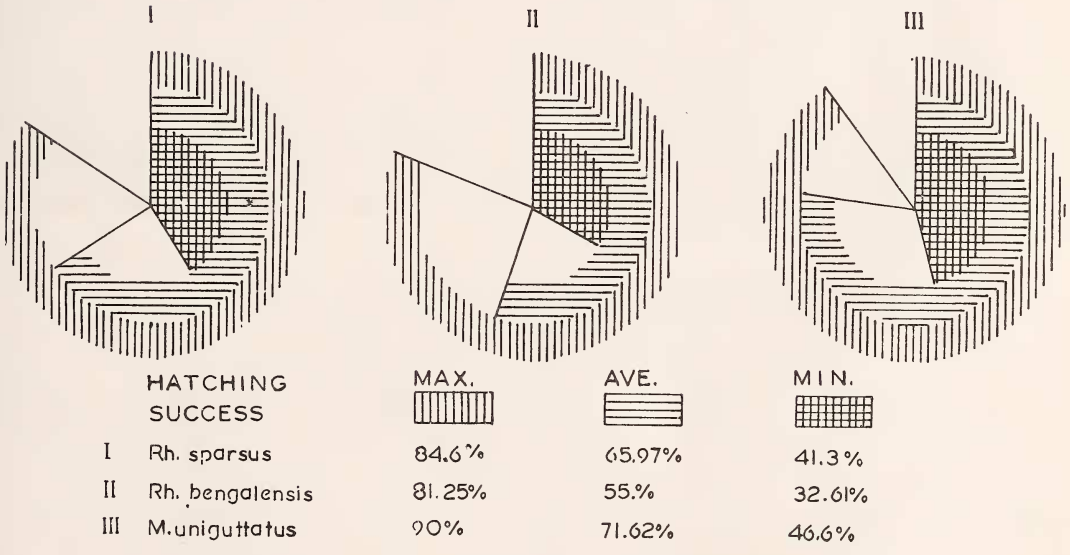


Fig. 2. Hatching success of three species of Rhyparochrominae.

Post embryonic development: Of the two species of *Rhyparothesus, Rh. bengalensis* interestingly took rather a longer period for its nymphal development than the other congener, *Rh. sparsus* (Table 3). The former, however showed an overlapping range of post-embryonic periods with *M. uniguttatus* (Fig. 3 A-E).

The maximum nymphal mortality of the rhyparochromines occurred in first and second instars, and when kept isolated, the mortality increased. Nymphs metamorphosed more successfully when reared in numbers in the same jar. Rough surfaces like fruit- rind, cotton-plug, piece of cloth were often preferred for casting the exuviae.

TABLE 2
COMPARISON OF INCUBATION PERIODS AND HATCHING SUCCESS OF *Rh. sparsus*, *Rh. bengalensis* AND *M. uniguttatus* EGGS
(BASED ON OBSERVATIONS OF TWELVE BATCHES OF EGGS)

	Incubation period (Days)	Successful hatching (%)
	Rh. sparsus	
Mean	4.33	65.97
Range	(3-5)	(41.3-84.6)
S.D.	0.577	12.87
	Rh. bengalensis	
Mean	6.25	55.0
Range	(4-8)	(32.61-81.25)
S.D.	0.753	11.73
	M. uniguttatus	
Mean	5.85	71.62
Range	(5-6)	(46.6-90.0)
S.D.	1.354	17.48

The egg: Eggs of *Rh. sparsus* and *Rh. bengalensis* are similar in general appearance. Freshly laid eggs are shiny, cylindrically ovoid, pale yellow (pearly), cephalic end slightly broader than the other. Maturing eggs turn reddish, showing red colour of the embryo's eyes. Under high magnification, chorion appears rough with rows of spiny warts and circlet of micropylar processes at the cephalic end (Fig. 4 A). *M. uniguttatus* eggs are more cylindrical with both the ends bluntly rounded. Freshly laid eggs were pale yellow but on maturity turned pink or reddish yellow. Deep red bands (impression of nymphal abdomen and eyes) were visible through the translucent chorion (Fig. 6 A).

Eggs of *M. uniguttatus* were greater in length and diameter than the eggs of other two *Rhyparothesus* spp. which showed overlapping ranges of measurements (Table 4).

Description of the nymphal instars: (Measurements in mm. are the means based on ten specimens). Nymphs of *Rh. bengalensis* closely resemble those of *Rh. sparsus* and are morphologically difficult to distinguish (specially the early instars) excepting when morphometrics are taken into account. So the following descriptions up to fourth instar in general hold good for both the species of *Rhyparothesus*.

1st nymphal instar: (Figs. 4B and 6B). *Rh. sparsus* and *Rh. bengalensis*: Head, pro-and meso-notum pale yellow; anterior abdomen and patch around dorsal abdominal scent-gland openings reddish yellow; eyes ruby red; pale yellow antennae with brown annular band at proximal region of pilosed 3rd and 4th segments; first segment with a fuscous thin proxi-

TABLE 3
COMPARISON OF STADIA AND POST EMBRYONIC DEVELOPMENT PERIOD OF *Rh. sparsus*, *Rh. bengalensis*, AND *M. uniguttatus*
(BASED ON TEN OBSERVATIONS)

(Days)	1st Instar	2nd Instar	3rd Instar	4th Instar	5th Instar	Total
			Rh. sparsus			
Mean	4.5	4.4	3.3	3.0	5.4	20.6
Range	(4-5)	(3-5)	(2-5)	(2-5)	(4-7)	(17-24)
S.D.	0.527	0.699	0.823	1.247	0.966	2.17
			Rh. bengalensis			
Mean	7.9	8.0	3.9	4.2	7.8	31.8
Range	(7-9)	(5-13)	(2-5)	(3-6)	(5-12)	(26-41)
S.D.	0.875	2.538	0.994	1.135	2.616	4.442
			M. uniguttatus			
Mean	6.7	6.8	5.1	5.8	10.0	34.4
Range	(6-8)	(6-8)	(4-6)	(5-7)	(8-13)	(30-38)
S.D.	0.823	0.788	0.737	0.788	1.699	2.674

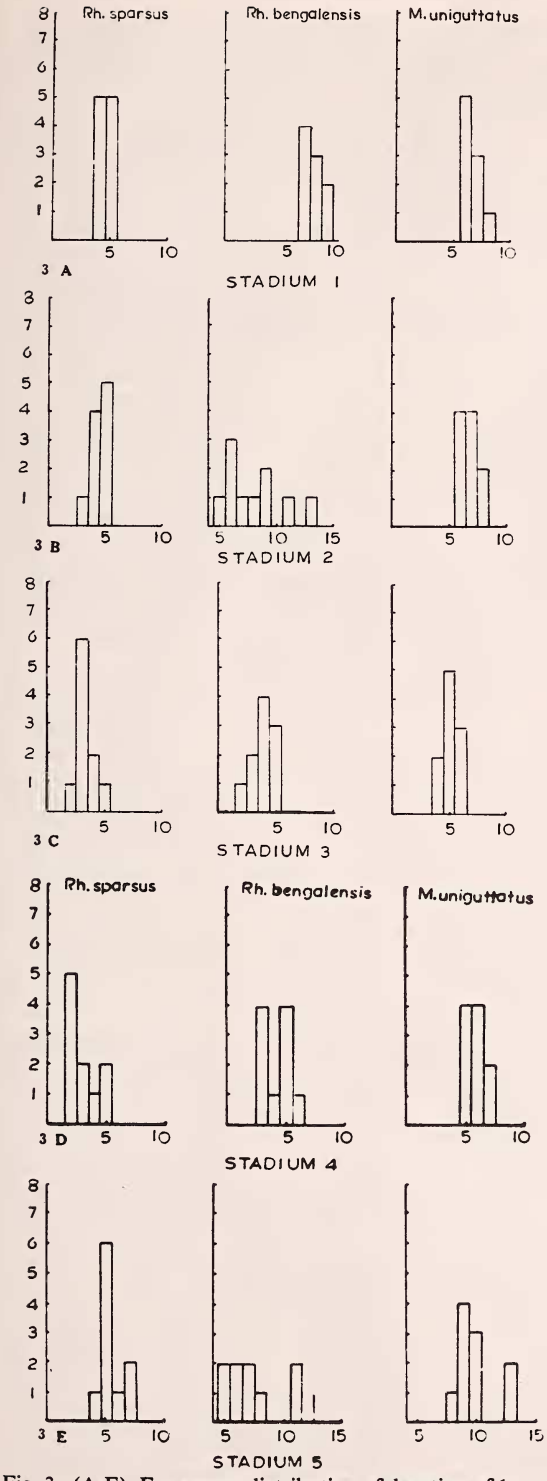


Fig. 3. (A-E). Frequency distribution of duration of 1st to 5th instars of three species of Rhyparochrominae. Abscissae, time in days; ordinates, number of observations.

TABLE 4

COMPARISON OF MICROPYLAR PROCESSES, LENGTH AND BREADTH OF *Rh. sparsus*, *Rh. bengalensis* AND *M. uniguttatus* EGGS (BASED ON TEN OBSERVATIONS)

	Micropylar processes	Length (mm)	Breadth (mm)
		Rh. sparsus	
Mean	6.0	0.89	0.43
Range	(5-7)	(0.85-0.9)	(0.4-0.45)
S.D.	1.0	0.02	0.02
		Rh. bengalensis	
Mean	5.6	0.92	0.41
Range	(5-7)	(0.89-0.96)	(0.36-0.48)
S.D.	0.894	0.112	0.192
		M. uniguttatus	
Mean	5.4	1.31	0.56
Range	(5-6)	(1.3-1.35)	(0.5-0.6)
S.D.	0.547	0.02	0.04

mal band; labial segments pale except brownish 1st and 4th segments; legs luteous, hind femora blackish, fore femora with one small spine located ventrolaterally at distal inner end; pleural and other coxal area brownish.

M. uniguttatus: Head and thorax deep brown; metathoracic region reddish membranous with a pair of brown rectangular sclerotization at metanotal region; eyes deep red; 1st and 4th antennal segment partly and 3rd fully fuscous; excepting 3rd, tip of 4th and 1st, 2nd labial segments fuscous; abdomen bright red with pale yellow colour between the red band of anterior abdomen and black plate surrounding scent glands on tergal segments 3rd- 4th, 4th-5th and 5th-6th; anal segment black; legs luteous with tibia light ochraceous; labium reaches 5th abdominal segment; 3 preorbital and 2 postorbital setae on head; 1st, 2nd antennal segments pubescent; anal segment with a pair of ventrolateral bristles; labial end with some and each thorax with a pair of setae on each side; mid ventral abdomen with sparse decumbent hair.

	Rh.sparsus	*Rh. bengalensis*	*M.uniguttatus*
Body length	1.4	1.37	2.01
Head width	0.37	0.34	0.5
Max. pronotal width	0.39	0.35	0.5

2nd nymphal instar: (Figs. 4C and 6C). *Rh. sparsus* and *Rh. bengalensis:* Brownish, closely resembles 1st instar excepting the following changes of characters; mesonotal brown colour reduced and confined to its anterior part; anterior abdomen with deep brown band (for yellow-red band of 1st instar) sparsed with pale small dots; dark brown patches present between dorsal scent gland openings of abdomen; 1st antennal segment with deep blackish annulation; pro- and mesonotum with lateral ampliation; fore femora black with single prominent spine; abdominal margins with brown patches at 2nd-3rd and 3rd-4th terga; labium reaches 3rd coxae.

M. uniguttatus: Dirty pale; head, thorax deep brown; first four tergal segments of abdomen pale yellow, rest dull red; sternum and abdomen ventrally pale; single seta present on each side of pro- and mesonotum; one pair of bristles on anal segment persists; some morphological changes from the 1st instar are, darker pro- and mesonotum with ampliate lateral margin; 'Y' suture present; labium reaching 3rd abdominal segment.

	Rh. sparsus	*Rh. bengalensis*	*M.uniguttatus*
Body length	1.83	2.03	2.99
Head width	0.51	0.48	0.65
Max. pronotal width	0.56	0.56	0.71

3rd nymphal instar: (Figs. 4D and 6D). *Rh. sparsus* and *Rh. bengalensis*: Brownish, resembling the 2nd instar nymph but larger and glossy; a few changes are, light brown colour of head and pronotum; well developed brownish mesonotum sparsed with few pale-yellow dots; tiny pale buds of meso-thoracic wing pads; brown markings around dorsal adbominal scent gland openings much dilute and sparse with pale dots; labium just reaches 2nd coxae; 2nd fore femoral spine developing.

M. uniguttatus: Ant mimic; 'Y' suture very prominent lined with dark stripes; 1st and 2nd tergal segment dark brown, 3rd and 4th relatively light and the rest light red; mesothorax shows posterior extension of wing pads, covering anterior part of metathorax; labium reaches 3rd abdominal segment; older 3rd instar nymphs are darker; setae on head, thorax and anal segments and median pale line of thorax obscure.

	Rh. sparsus	*Rh. bengalensis*	*M.uniguttatus*
Body length	2.76	2.94	4-.13
Head width	0.69	0.68	0.85
Max.pronotal width	0.83	0.86	0.86

4th nymphal instar: (Figs. 4E and 6E): *Rh. sparsus* and *Rh. bengalensis*: General appearance brown, mixed with pale yellow and abdomen with tint of red; perceptible changes over 3rd instar are the arborescent designs of brown and pale markings on head, pro- and mesonotum; mesothoracic wing pads well developed which cover almost whole of the metanotum; tibiae with rows of well developed bristles; antennal and labial segments largely (mostly) brown; fore femora with two prominent and few budding spines; major part of femora, tibiae and distal tarsal joint brown.

M. uniguttatus: Ant mimic; back with reddish abdomen; head, pro- and mesonotum black; 1st and 2nd abdominal segment blackish; 'Y' suture prominently lined with white stripe, dark patch between 2nd and 3rd scent gland openings of abdomen; wing pads extend up to 1st abdominal segment; small fine setae on head, pro- and mesonotum; single spine in anterior femora well developed and small spines present on tibiae; labium reaches posterior coxae.

	Rh. sparsus	*Rh. bengalensis*	*M.uniguttatus*
Body length	3.64	4.07	5.91
Head width	0.92	0.9	1.13
Max. pronotal width	1.25	1.27	1.23

5th nymphal instar: (Figs 4F and 6F). *Rh. sparsus* and *Rh. bengalensis:* Pale brown differs from 4th instar in having triangular head designed with brown markings on pale yellow; trapezoidal pronotum with laminated ampliated margins and variegated designs made of yellow, brown and red patches; mesothoracic wing pads underlined by metathoracic wing pads extend beyond middle of 3rd abdominal segment; scutellar impression present in bet-

ween the wing pads; femora with black punctures and six or more prominent spines.

5th instar nymphs of *Rh. bengalensis* differ from that of *Rh. sparsus* in the following characters; Trochanter of anterior leg pale as compared to black; anterior and lateral part of metapleuron with an obscure pale spot; overall dorsal appearance paler; pair of blackish patch in mid dorsal region of anterior and posterior margin of pronotum obscured by suffused pale small spots (dots) as compared to prominent and broad black patches in the same position, without any pale spot (Fig. 5).

M. uniguttatus: Ant mimic, older nymphs black; 2nd and 3rd coxae, trochanter, proximal femoral region pale; 1st and 4th rostral segment black; 4th antennal segment with a white ring; head, pro- and mesonotum, wing pads and first three abdominal segments black; rest of the abdomen with dirty pale spots; pro- and mesonotum with setae; wing pads extend up to the middle of the 3rd tergal segment; labium reaches 4th abdominal segment; fore femur with four prominent spines and all tibiae with spinous setae.

	Rh. sparsus	*Rh. bengalensis*	*M.uniguttatus*
Body length	5.3	5.36	8.1
Head width	1.1	1.1	1.46
Max. pronotal width	1.76	1.73	1.84

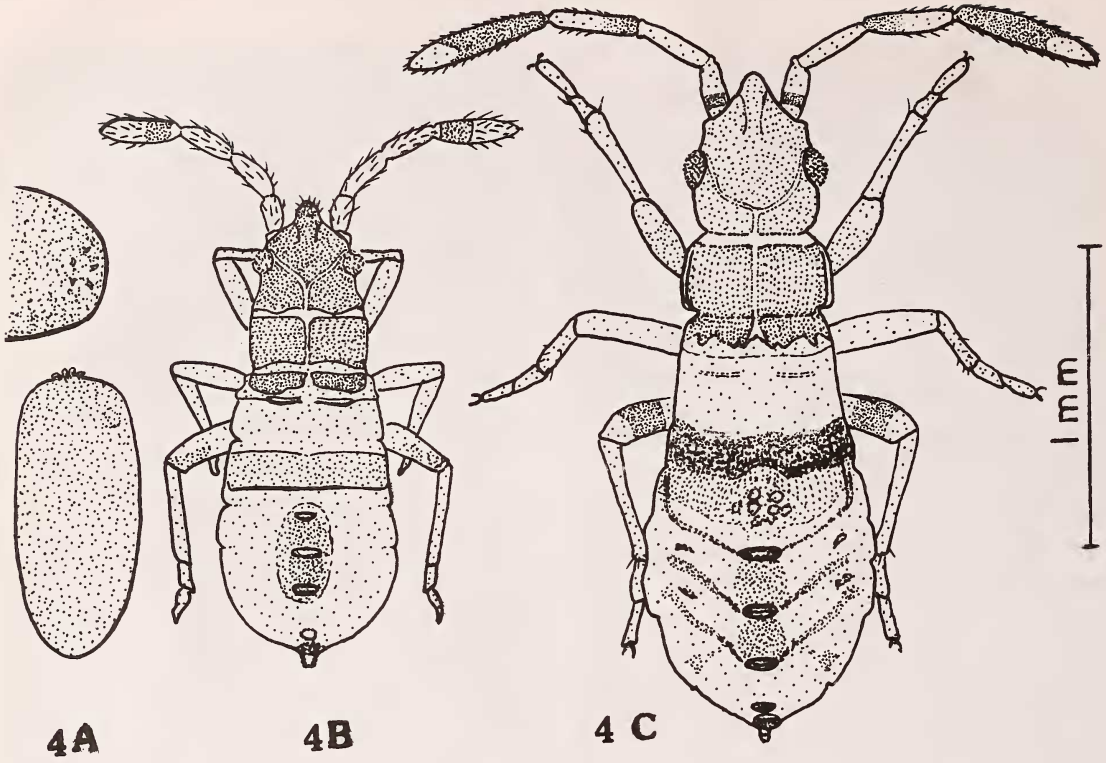
Adults: (Figs. 4G and 6G). Morphology of *Rh. sparsus* is adequately described by Distant (1904) and *Rh. bengalensis* by Distant (1910); *M. uniguttatus* is described by Thunberg (1822) and subsequently repeated by Distant (1904) in Fauna of British India, Rhynchota. So, the description of the adults are not unnecessarily repeated here. However, a comparison of their morphological measurements (averages) is provided.

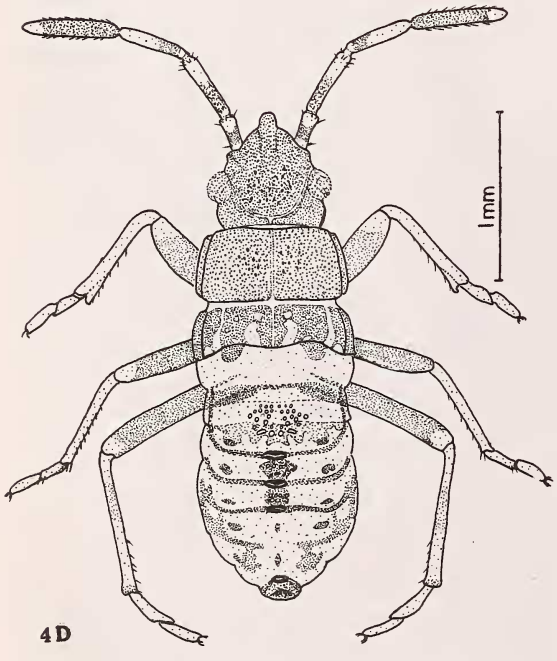
	Rh. sparsus	*Rh. bengalensis*	*M.uniguttatus*
Body length	6.89	5.95	12.40
Head width	1.25	1.14	1.76
Max. pronotal width	2.23	2.05	2.91

Enemies and defence: Birds like Common Myna [*Acridotheres tristis* (Linn.)], Magpie Robin [*Copsychus saularis* (Linn.)], domestic chicks, at times Fivestriped Squirrel (*Funambulus pennanti* Wroughton) and also probably skinks and toads picked *Rh. sparsus* and *Rh. bengalensis* from the litter. The enemies of *M. uniguttatus* could not be properly observed. Though a number of predators like spiders, mantids, reduviids, anthocorids and geocorines (predatory lygaeids) were little noticed yet these invertebrates had an appreciable capacity to attack soft-bodied nymphs of *Rhyparothesus* and *Metochus* species, and a few other lygaeids like *Botocudo* and *Appolonius* of the same litter habitat as well.

The defence mechanism of adults and advance nymphs of *Rh. sparsus* and *Rh. bengalensis* seemed to be their sordid concealing colour, that exactly matched the background of dry leaves and fruits in the litter. So, in still condition these were indistinguishable from the substrate below. *M. uniguttatus* however, tried to find cover to avoid enemy, in cracks, crevices, under stones or litter particles. Another mode of defence was by escaping, when disturbed, by scattering at bewildering speed, so that the enemy got too puzzled to concentrate on any one of them. After feeding, the *Rhyparothesus* spp. often took refuge in inaccessible crevices or inside leaf rolls to escape notice. A special kind of defence mechanism was by adopting mimicry. The shape and the colour of the 1st and 2nd nymphs of *Rhyparothesus* spp., especially their dirty yellow abdomen, highly resembled and matched the mature fig seeds, so that, when feeding on exposed fruits, they were indistinguishable. Adults and advanced nymphs of *M. uniguttatus* were observed to have very close resemblance to different ant species, mantid nymphs, and spiders (since the latter also mimicked ants of the same habitat).

Variation in size and colour: The colour of *Rh. sparsus* and *Rh. bengalensis* seemed to depend on the season and availability of food. In drier seasons the bugs generally had a darker shade and grew smaller in size. The variation of size within the same population was more evident in *Rh. bengalensis* than in *Rh. sparsus* or *M. uniguttatus*. Nevertheless, in the latter species sexual dimorphism was noticeable. Thangavelu (1978b) reported antennal oligomery in





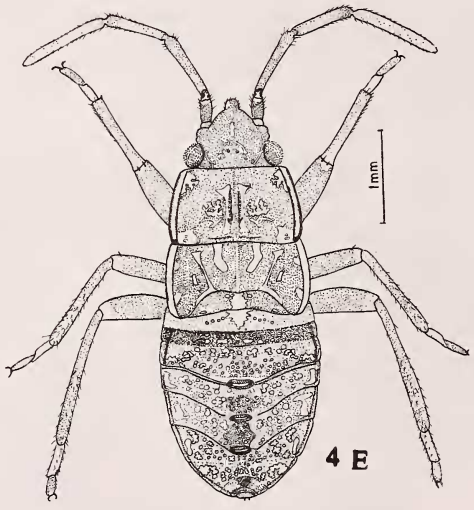
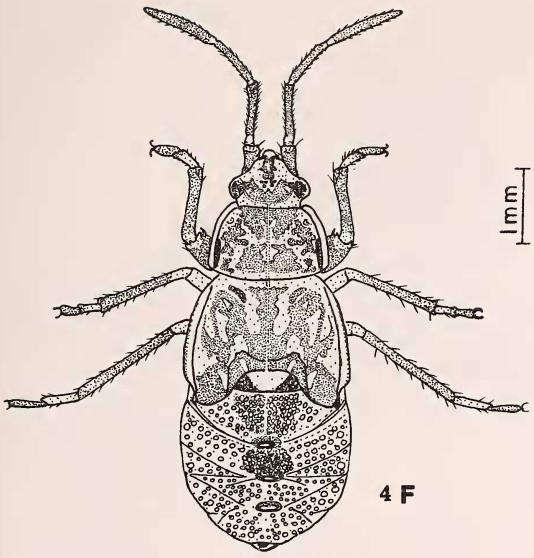


Fig. 4. (a-e). Stages of life cycle of *Rhyparothesus sparsus* (dorsal views).

a. Eggs showing warty chorion and cephalic end with micropylar processes; b. 1st instar nymph; c. 2nd instar nymph; d. 3rd instar nymph.

e. 4th instar nymph.



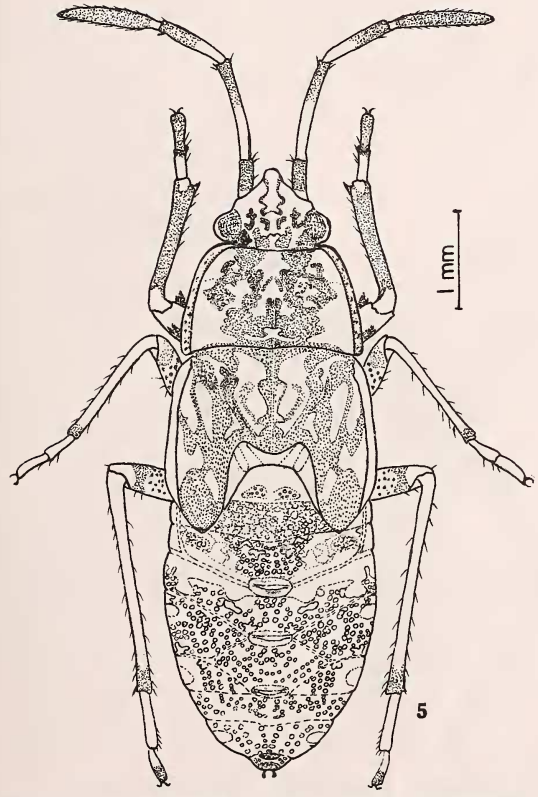
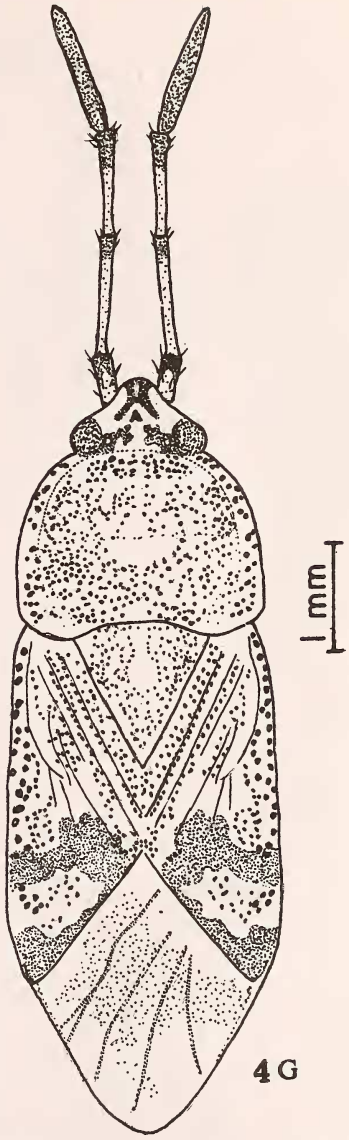
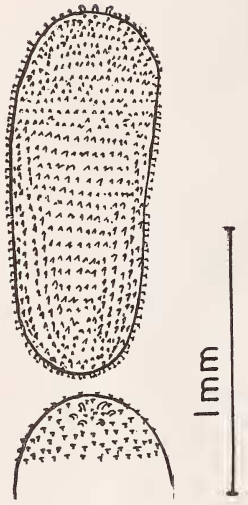


Fig. 5. 5th instar nymph of *Rhyparothesus bengalensis*.

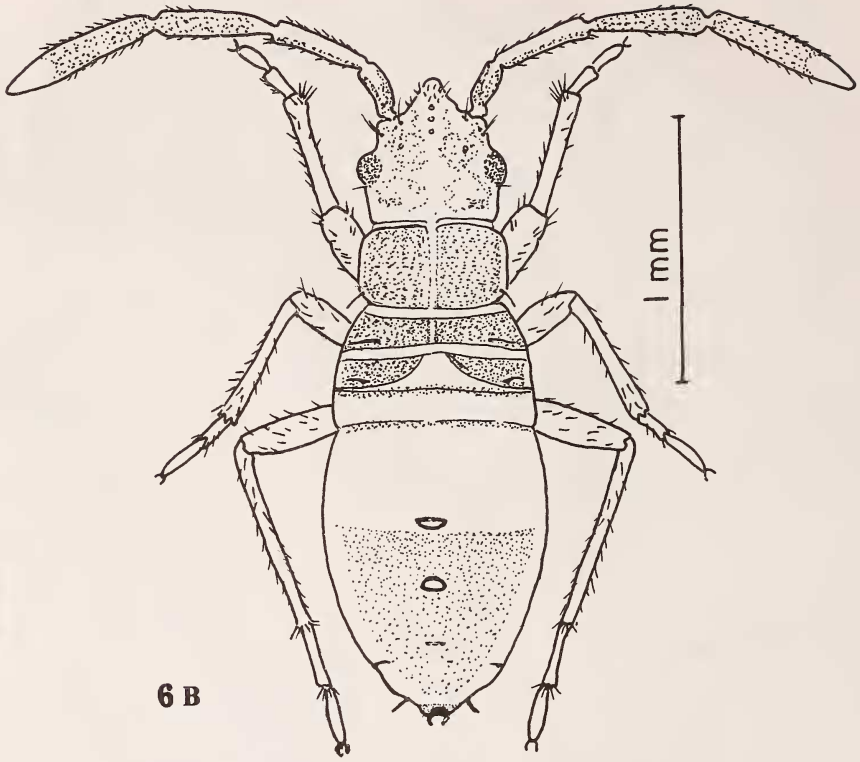


Rhyparothesus sparsus (dorsal view).
Fig. 4f. Fifth instar nymph; 4g. Adult.

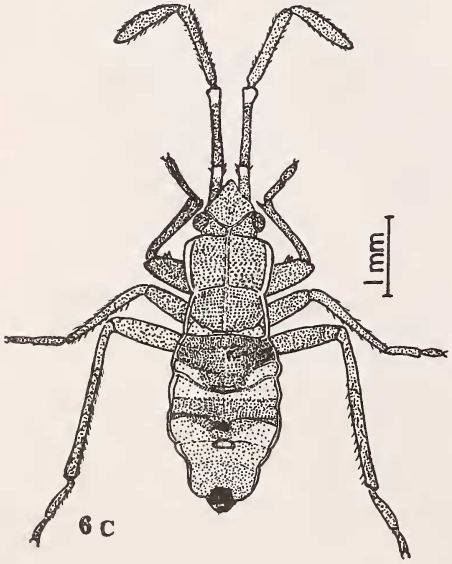
[1]This paper constitutes a part of the Ph.D. thesis, entitled "Taxonomy of lygaeid bugs (Heteroptera : Inseeta) from West Bengal with aspects of bioecology of some representative species" that was submitted to the University of Calcutta with the subsequent award of the degree in 1983. The project was financed by Dept. of Science and Technology through Zoological Survey of India fellowship during the period 1978 to 1981.



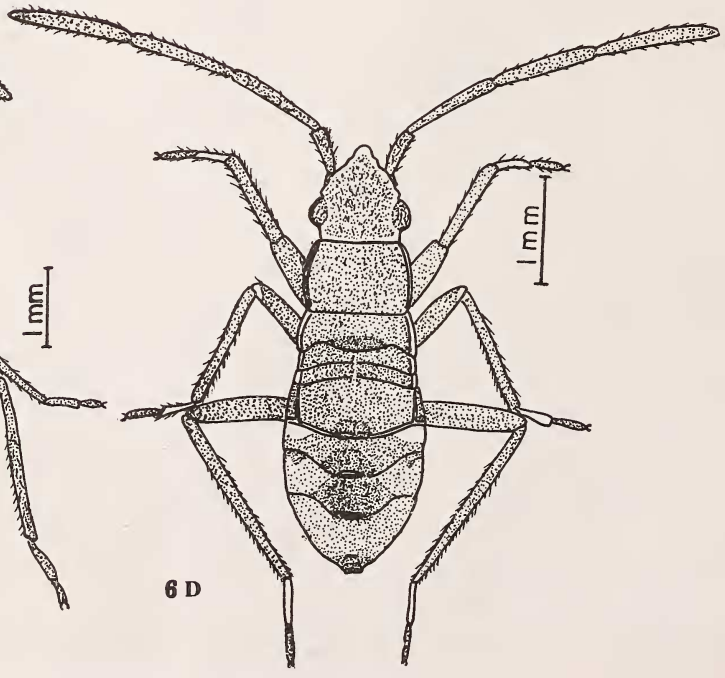
6 A



6 B



6 C



6 D

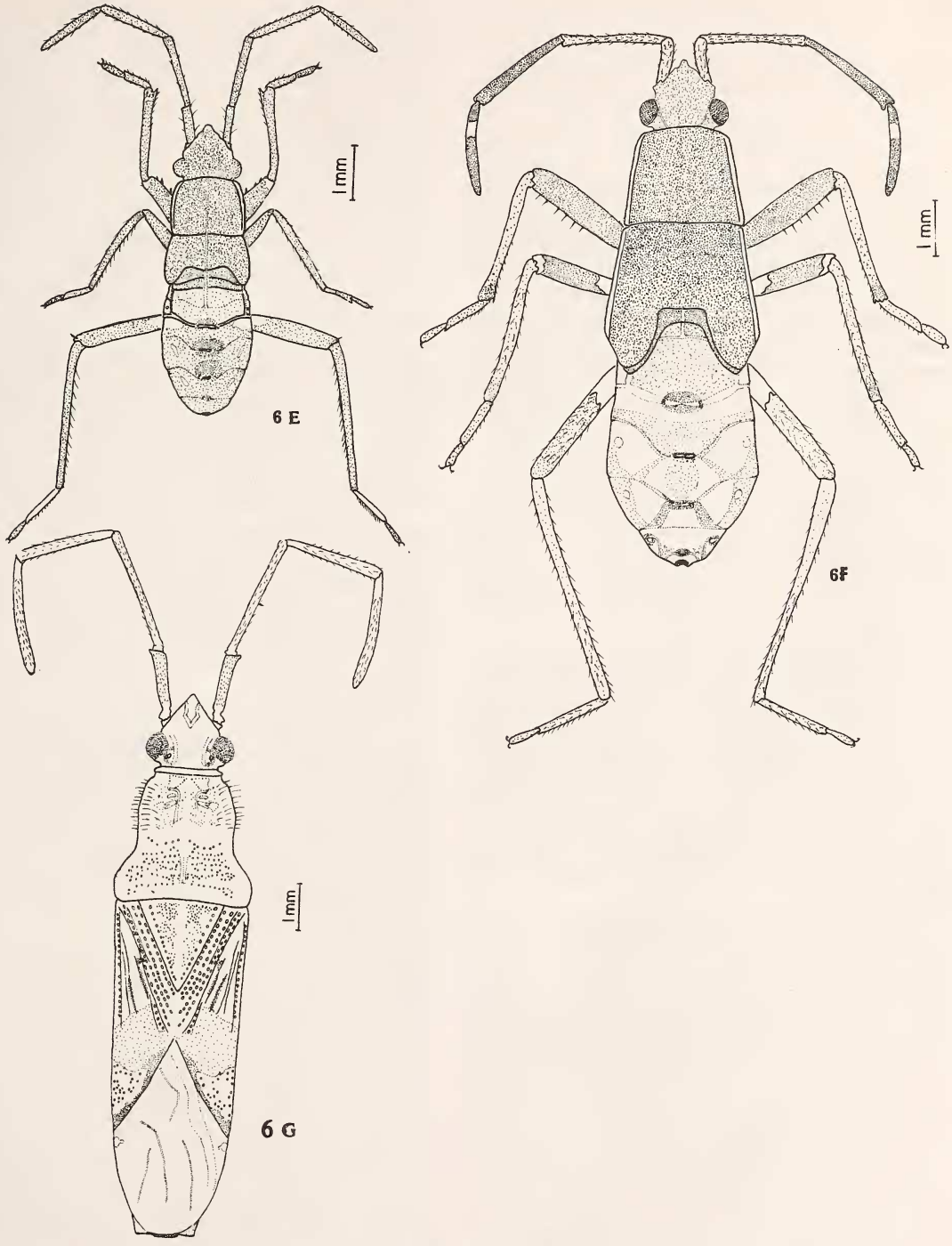


Fig. 6. (a–g). Stages of life cycle of *Metochus uniguttatus* (dorsal view).
a. Eggs showing cylindrical structure and circlets of micropylar processes; b. First instar nymph; c. Second insta nymph; d. Third instar nymph. e. Fourth instar nymph; f. Fifth instar nymph; g. Adult.

populations of *M. uniguttatus* from south India but no such variation was evident from West Bengal. Only a few nymphs of *Rh. sparsus,* however, showed three segmented antennae.

Discussion

The two species of Rhyparochrominae, *Rhyparothesus bengalensis* and *Rh. sparsus,* that are chiefly confined to the fig litters and litters of a few other plant families of the tropics, have so far been found endemic to the Indian subregion. The possibility of their presence in other tropical countries of the Orient, where the typical host plants exist, is fair; due to lack of extensive survey and intensive search for these procryptic forms in the litter habitats, particularly in the fruiting seasons, the nature of their true distribution is unknown. The more active and polyphagous rhyparochromine, *Metochus uniguttatus,* because of its fast running and flying activities probably has a wider distribution in the tropics and subtropics, namely China, Philippines, Indochina and Indonesia (Slater 1964).

The occurrence of all the three species in the fig litter habitat is principally governed by the availability of food rather than ambient condition. The fig-litter though apparently gives the impression of a permanent habitat is in reality a temporary one. However, for breeding they prefer moderate temperature of spring and autumn synchronized with the availability of food. So, these seasons suited laboratory rearing ideally.

Slater (1972) while studying the fig trees and the associated lygaeid fauna in South Africa and West Indies observed that various species of birds and monkeys regularly fed on the fig fruits. Almost a parallel situation was observed for the *Ficus* spp. in lower West Bengal. The birds and mammals were greatly responsible for preparing the temporary (subclimax) fig-litter habitat congenial to feeding and breeding activities of the lygaeids. The major associated species of birds and mammals during their feeding activity (list provided in appendix 1) wasted and dropped much of the fruits from syconium. Even their droppings (faeces), containing undigested or semi-digested seeds, formed an important dietary item of the litter lygaeids. So the commensalistic role of these vertebrates was quite apparent.

As a member of pentatomorpha, lygaeid eggs lack a true operculum and have an anterior ring of varying number of micropylar processes (5-9) for sperm passage and air exchange (Sweet 1964). The micropylar processes of the three rhyparochromine species ranged between 5 to 7 and, therefore, are in conformity with the above information.

Sweet (1964) observed for rhyparochromines that the embryonic cuticle in all cases were shed after complete emergence from eggs. However in the present study the reason for rupture of the embyonic membrane at different stages, like when the nymph is well inside the chorion, when half its way out, or after complete emergence could not be properly understood. Another difference noticed was that the successful hatching took place simultaneously with nymphal mortality from the same batch of eggs of the same female, the latter taking place when the wriggling nymphs were unable to free themselves of the embryonic membrane, probably due to stiffening of the membrane by drying.

The egg-laying habit of *Rh. sparsus* and *Rh. bengalensis* agrees with Sweet's observation (1964) on litter dwelling New England rhyparochromines. These bugs mostly preferred loose soil for laying. In order to choose oviposition site, as already described, the bugs stimulated the sensory hairs of their ovipositors by repeated probing and lifting the egg-laying organ in the form of plough on the soil surface, which was followed by oviposition. The egg-laying trend of the three rhyparochromines showed a general pattern, with a steady increase in the number of eggs/day/ female in first half of the oviposition period and a steady decline in the second half (Fig. 1). However, *M. uniguttatus* at the end of the oviposition period had a steep decline in the rate of egg laying, which may be due to the mortality of most females in laying condition as these were reared on *Ficus hispida* fruits, probably a not much preferred host plant or not an ideal one for stimulating oviposition.

Eyles (1963) indicated that the nymphs of

several species of *Scolopostethus* were not distinguishable in the field and the larval body measurements were similar in all the species studied in the genus. Almost a parallel example of this paradoxical situation are the immature stages of the two species of *Rhyparothesus, Rh. sparsus* and *Rh. bengalensis* almost sharing the same ecological niche. The first four instars having very close similarities, even had their morphometrics overlapping.

Unlike Sweet's (1964) observation of a longer development period for smaller bugs, *Antellocoris*, and shorter for the larger species of *Ligyrocoris*, the overlapping ranges of the post embryonic development period of the three species suggests that the development rates may be dependent on the adaptations to the habitat, food, seasonal cycles, and surrounding conditions, but not to the size of the rhyparochromine bugs.

As none of the three species showed any preference for probing any particular site of a seed, it is probable that they feed on the endosperm and the embryo indifferently, unlike one that is found in *Drymus sylvaticus* that only feeds on the embryo of seeds (Eyles 1964).

The extreme example of seed defence behaviour was where the bugs fight physically over a seed, as observed by Sweet (1964) for *Pachybrachius*. This was found to be common among the males of *Rh. sparsus* and *Rh. bengalensis*, who sometimes fought even without a seed in possession, thus indicating that such disputes were not always over food directly but possibly over territory of feeding and stored food safety.

The rhyparochromines in general show mating behaviour where the male vibrates the antennae rapidly near the female and climbs upon her deliberately (Sweet 1964). The two *Rhyparothesus* species showed no exception to this habit, but because *M. uniguttatus* produces a feeble sound by stridulating hind tarsi against hemielytral surface (Thangavelu 1978a) it is likely that the sound is involved neither in offence nor defence but in courtship. So, mating behaviour of this rhyparochromine would better fit a different category where the male employs a forefemoral activity (stridulations) and vibrating antennae, as has been suggested for the long-legged Myodochini by Sweet (1964).

While some ant mimicry of interest from Indian subregion is reported by Thangavelu (1978a) there seems to exist certain mimicry complex in some of the fig-litter habitats as observed in West Bengal. Ants, spiders, nymphs of mantids, and adult and nymphal lygaeids often coexisted with close mimicry. All showed a convergent adaption, but it was difficult to ascertain the model and the mimic in such a situation. Conventionally, however, ants might be taken as a model since most nymphs of mantids *Gonypeta* sp., and most adults and nymphs of lygaeids like *Pachybrachius pallicornis, Metochus uniguttatus, Pseudopachybrachius guttus*, and *Appolonius* spp. resembled one or the other species of ants of the same habitat. *Gonypeta* sp. which predated on other insects might be thought to have aggressive mimicry in resembling the ant *Diacamma vagans*; such resemblance was also found common in an ant-like spider of the same habitat.

Colour and size variations observed in *Rh. sparsus*, and *Rh. bengalensis* seem partly due to the change in the same habitat, and the state of food and moisture available at different seasons. The light and dark shades of the same bug may be due to change in its physiology that depends on its diet.

So, the study of the life styles of the three commonly occurring rhyparochromine bugs of the fig-litters reflect certain important ecological aspects that also hold good for most other seed-feeding bugs of the same habitat. Apart from their untiring role as reducers and secondary decomposers of litters to replenish the soil nutrients, their noble involvement in seed dispersal because of their seed-defence behaviour has to be appreciated in context with today's crying need for expansion of mixed type forests to restore the environmental balance.

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Appendix 1

LIST OF HIGHER VERTEBRATES PARTICIPATING IN COMMENSALISM

Common Names	ScientificNames
Birds	
Common Myna	*Acridotheres tristis*(Linn.)
Greyheaded Myna	*Sturnus malabaricus*(Gemelin)
Large Green Barbet	*Megalima zeylonica*(Gmelin)
Coppersmith or the Crimsonbreasted Barbet	*Megalaimahaemacephala*
Koel	*Eudynamys scolopacea* (Linn.)
Common Green Pigeon	*Treron phoenicoptera*(Latham)
Redvented Bulbul	*Pycnonotus cafer*(Linn.)
Redwhiskered Bulbul	*Pycnonotus jocosus*(Linn.)
Grey Tit	*Parus major* Linn.
Mammals	
1. Fivestriped Palm squirrel	*Funambulus pennanti* Wroughton
2. Fruit Bat	*Cynopterus sphinx* Vahl